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(54) Abstract Title
Improvements to hi-fidelity and home entertainment systems

(57) Apparatus for implementing various configurations of high fidelity and home entertainment systems, comprises of a plurality of card modules, each card performing a sub function of the overall system, can be combined in an efficient way to form a modular and expandable system. Many of today's' entertainment systems employ duplicate functions. These individual systems can be partitioned so similar functions are shared in the said apparatus allowing different system configurations to share common resources and optimise overall system functionality and performance.

The cards are housed in a modular card frame with connection means to a backplane. Each card itself is a modular system with means to insert sub function mezzanine boards enabling systems to be upgraded inexpensively.

Card module inter communications is either by backplane means or data packets routed by switching means. To enable digital processing of signals, analogue signals can be converted to a digital format.

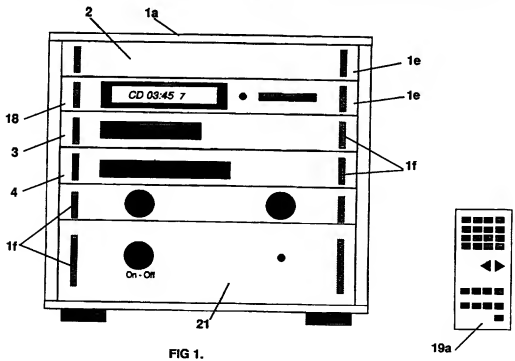

FIG 1.

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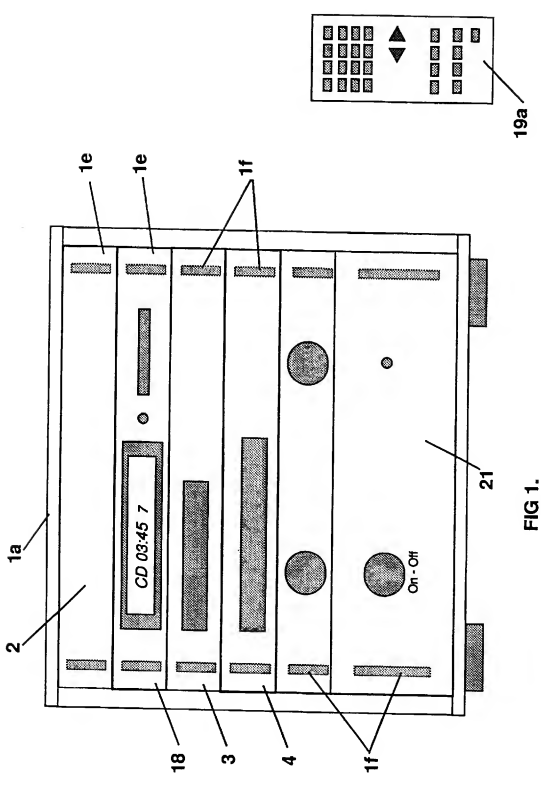

FIG 1.

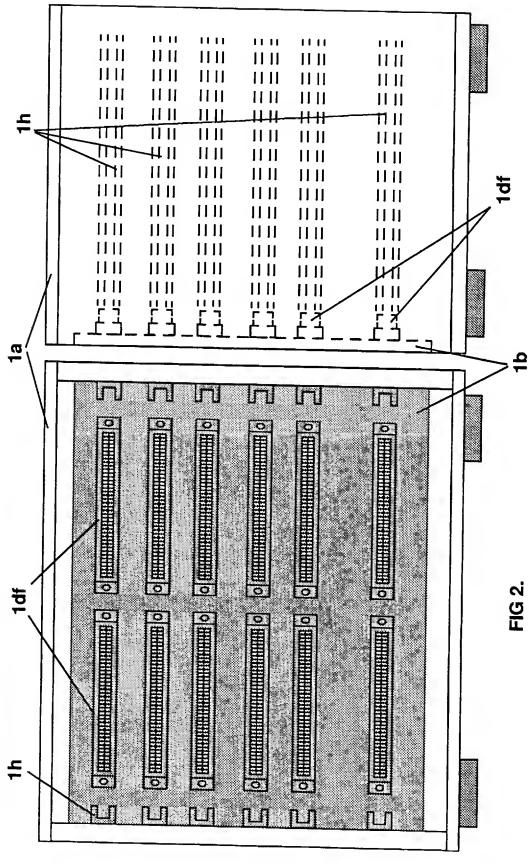

FIG 2.

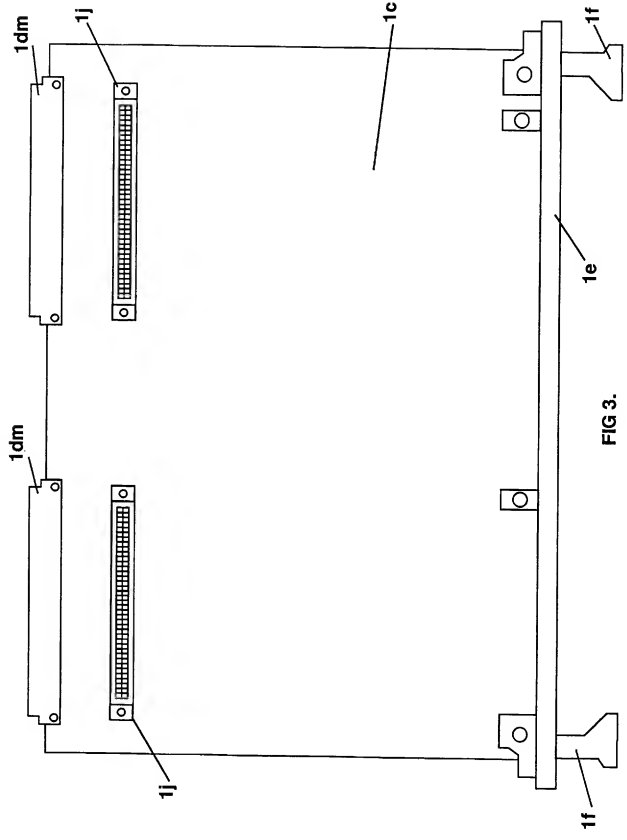

FIG 3.

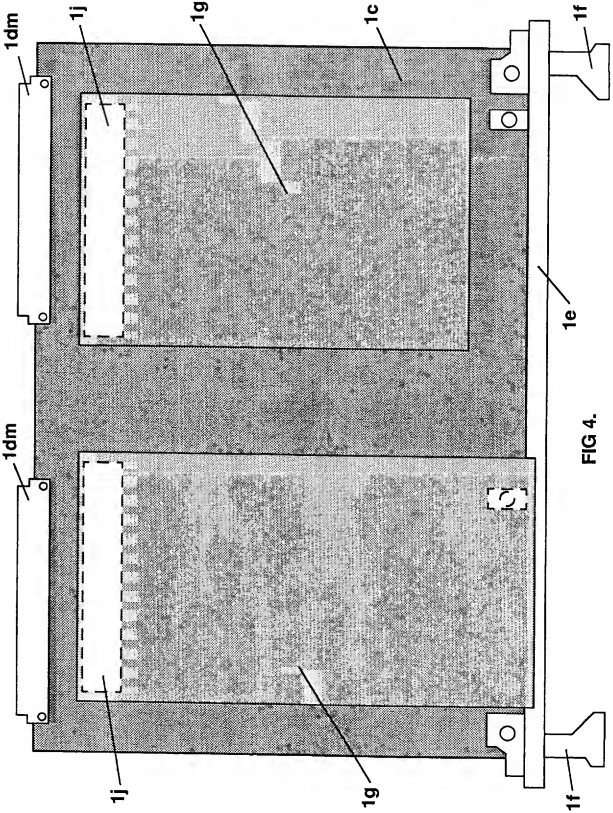

FIG 4.

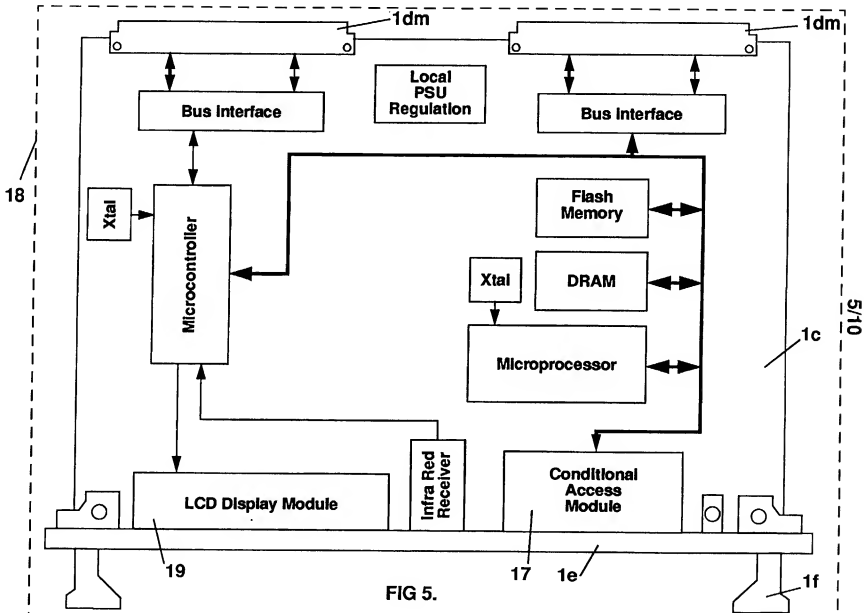
1dm
1dm
Local
PSU
Regulation
Bus Interface
Bus Interface
18
Xtal
Microcontroller
Flash
Memory
Xtal
DRAM
Microprocessor
1c
Infra Red
Receiver
LCD Display Module
Conditional
Access
Module
19
17
1e
1f

FIG 5.

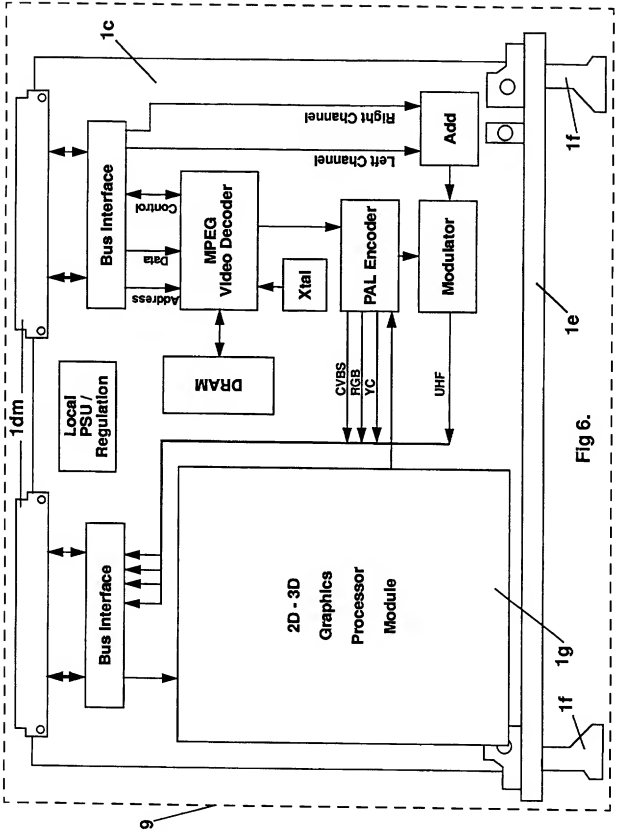
1c
Right Channel
Left Channel
Add
1f
Bus Interface
Control
Data
Address
MPEG
Video Decoder
Xtal
PAL Encoder
Modulator
1dm
Local
PSU /
Regulation
DRAM
CVBS
RGB
YC
UHF
1e
Bus Interface
2D - 3D
Graphics
Processor
Module
1f
1g
9

Fig 6.

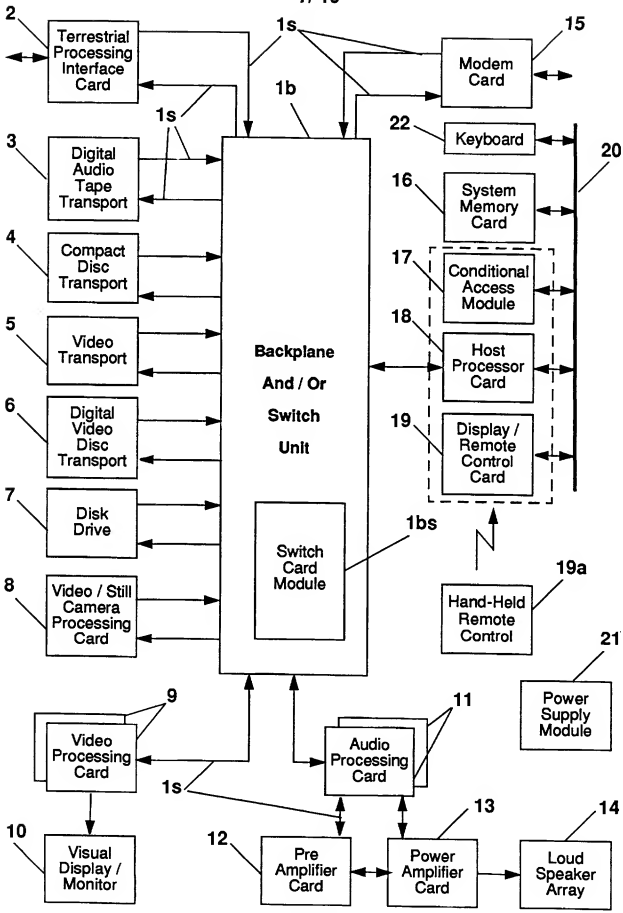
2
Terrestrial Processing Interface Card
1s
15
Modem Card
1b
1s
22
Keyboard
20
3
Digital Audio Tape Transport
16
System Memory Card
4
Compact Disc Transport
17
Conditional Access Module
5
Video Transport
18
Host Processor Card
Backplane And / Or Switch Unit
6
Digital Video Disc Transport
19
Display / Remote Control Card
7
Disk Drive
1bs
Switch Card Module
19a
8
Video / Still Camera Processing Card
Hand-Held Remote Control
21
Power Supply Module
9
11
Video Processing Card
Audio Processing Card
1s
10
Visual Display / Monitor
12
Pre Amplifier Card
13
Power Amplifier Card
14
Loud Speaker Array

Fig 7.

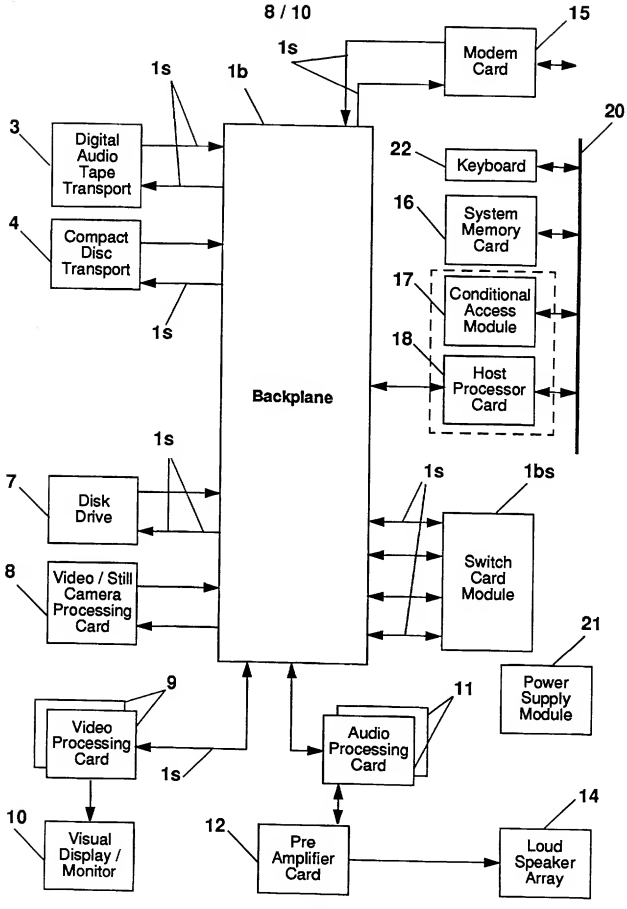
15
1s
Modem Card
1s
1b
20
3
Digital Audio Tape Transport
22
Keyboard
16
System Memory Card
4
Compact Disc Transport
17
Conditional Access Module
1s
18
Host Processor Card
Backplane
1s
7
Disk Drive
1s
1bs
Switch Card Module
8
Video / Still Camera Processing Card
21
Power Supply Module
9
11
Video Processing Card
Audio Processing Card
1s
10
Visual Display / Monitor
12
Pre Amplifier Card
14
Loud Speaker Array

Fig 8.

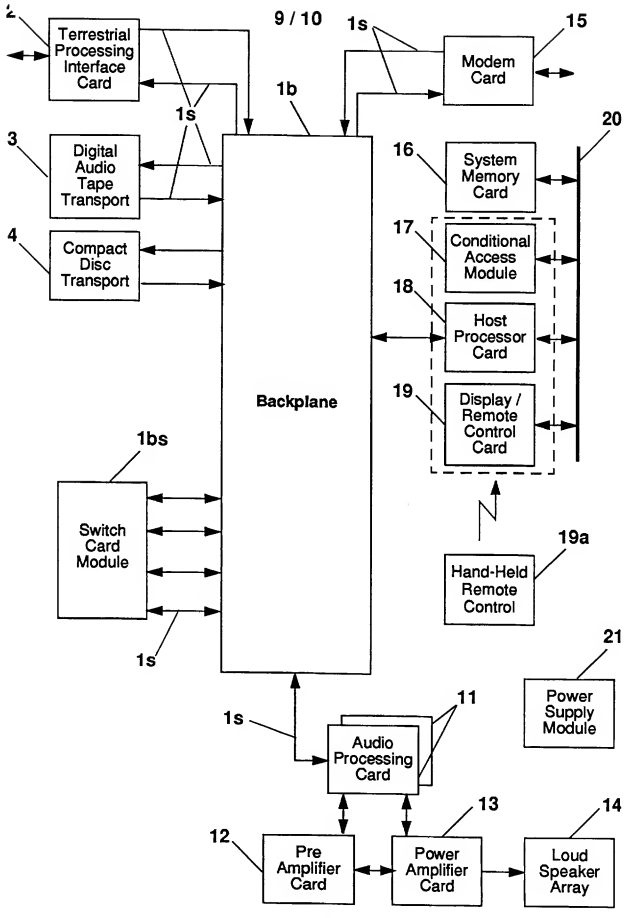
2
Terrestrial Processing Interface Card
9 / 10
1s
15
Modem Card
1b
1s
20
3
Digital Audio Tape Transport
16
System Memory Card
17
Conditional Access Module
4
Compact Disc Transport
18
Host Processor Card
Backplane
19
Display / Remote Control Card
1bs
Switch Card Module
19a
Hand-Held Remote Control
1s
21
Power Supply Module
1s
11
Audio Processing Card
13
14
12
Pre Amplifier Card
Power Amplifier Card
Loud Speaker Array

Fig 9.

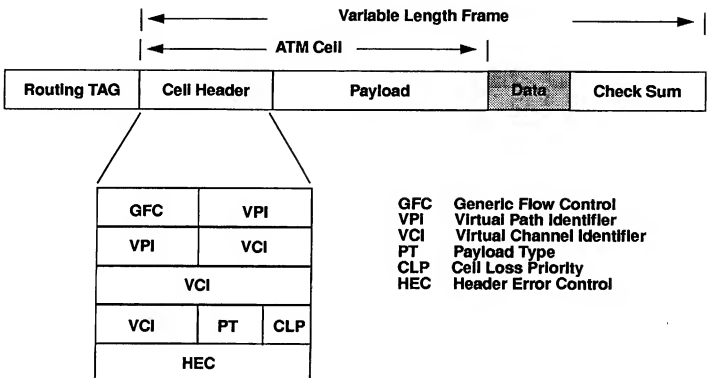
Variable Length Frame
ATM Cell
Routing TAG
Cell Header
Payload
Data
Check Sum
GFC
VPI
VPI
VCI
VCI
VCI
PT
CLP
HEC
GFC Generic Flow Control
VPI Virtual Path Identifier
VCI Virtual Channel Identifier
PT Payload Type
CLP Cell Loss Priority
HEC Header Error Control

FIG. 10.

IMPROVEMENTS TO HIGH-FIDELITY AND HOME ENTERTAINMENT SYSTEMS

This invention relates to high fidelity and home entertainment systems.

Today's high fidelity and home entertainment systems are partitioned into separate functional blocks using both digital and analogue technologies. They usually comprise system building blocks such as a pre amplifier, power amplifier, compact disc (CD) player, laser disc player, tape cassette player, Digital Audio Tape (DAT) player, video recorder (VCR), Personnel Computers (PCs), satellite decoders or cable decoder. They also include output unit such as CRT, flat screen monitors for displaying images and loudspeakers and headphones for outputting sound.

With greater integration in silicon technologies many functions have been combined to form systems on a chip and bring audio, visual and data functions together to realise multi-media systems. No where is this more true in personal computers (PCs) which exploit the use of these technologies to implement multi-media software for games and commercial applications. In fact, with the improvement in digital communication techniques such as digital terrestrial broadcast, faster Internet services using high speed Digital Subscriber Line (xDSL) links, PCs and other home entertainment systems are being merged to form integrated systems.

With the increase in silicon gate counts and the use of mixed signal technologies comes better system performance and the chance to implement new techniques and / or algorithms which exploit the improvements high speed, high resolution digital technologies bring i.e. graphics, 3D sound and high speed telecommunication transport. However, for manufacturers to gain market advantages and exploit greater processing power data needs to be transferred at every greater rates which requires new interfaces (such as Universal Serial Bus (USB), Firewire, xDSL and wireless access such as Bluetooth. Consequently, interfaces and processors are constantly being developed every 12 - 18 months requiring the customers to update their systems to stay "in touch". Though many of these systems are backward compatible, this leads to reduced performance, with systems requiring more software and processing power to execute the required functions. Also, not all manufactures sign up to the same interface consortiums and differences exist in similar equipment. An example would be the recent introduction of digital terrestrial television and digital satellite television in which both set top boxes use MPEG2 video transport but the former is received via a conventional television aerial and the latter by a satellite dish.

However, with the development of international standards such as Moving Picture Expert Group (MPEG), many of today's and tomorrow's multi-media systems use these video and audio standards. Digital Audio Broadcast (DAB) uses MPEG 2 Audio, new Set Top Boxes (STBs) based on the xDSL use MPEG 2 Video and Audio standards for the deliver of video to the home,

many Internet services will use MPEG2, MPEG4 and MP3 audio compression standards. Being able to swap between the different formats without having to substitute whole equipment boxes would be a great advantage and cheaper for the user. New standards are constantly being developed e.g. MPEG4 and MP3.

However, as stated above, many of these systems replicate certain key functional blocks. When expanding or upgrading a system whole units need to be replaced. This can be expensive and a waste of functional blocks which are effectively replicated and left idle when not in use. It would appear that today's hi-fidelity and home entertainment systems are partitioned incorrectly.

For example, all of today's system elements require power supply units (PSUs), many have separate remote control units, separate LCD displays, separate digital processors for MPEG 2 video and audio codecs (for which there are many international standards e.g. G.724, CELP and RELP), separate digital to analogue converters (DACs), separate pre amplifiers and power amplifiers. All of which are housed in separate equipment boxes. Therefore, when expanding or upgrading a system many of the system units contain repeated functional blocks. Also, many different systems require interface upgrades which requires changing more than the interfaces, usually a whole system element needs to be replaced and new hardware and software installed. In fact, interfacing between system elements can be one of the most complex problems to overcome as many new interfaces rely on software protocols to implement their functionality. For example Universal Serial Bus (USB), Firewire (1394 standard) and UTOPIA Level 2 interfaces.

Interconnection between the various equipment boxes requires many cables and power supply connections and tends to be unwieldy.

According to the present invention there is an integrated home entertainment and telecommunication apparatus comprising an expandable modular card frame means, an associated backplane system for distributing both analogue and digital signals together with power supply signals to each card location, a plurality of card modules each including connector and interface means for interfacing to the said backplane, each card module performing a sub function of the desired overall system and optionally having means to support mezzanine cards for implementing more sophisticated additional support functions, in such apparatus the system functionality being partitioned amongst the various modular cards in such a way as to optimise overall system functionality by allowing different system configurations to share common functional resources, hence reducing duplication of certain common functions, these said cards consisting of;

- internal data source card modules providing a data stream from stored media means,

- external data interface card modules which interface the said apparatus to externally generated data or signals,

- a switching or routing card which transfers data packets to and from the various source and destination functions within the said apparatus based on an appended routing tag and or an enclosed address field,

- digital and analogue processing cards incorporating signal processing means for processing common (similar) data from a plurality of input card modules, the said processed data being transferred to one or several of a plurality of selected output cards using appropriate interfacing means,

- output card module means for transferring the received processed data in the correct format to signal sink means,

- and power supply cards for providing and distributing power to the plurality of cards in the assembled apparatus.

With such apparatus, manufacturers will be able to provide card modules for the different system functions. Users will then be able to construct a system and use existing card modules to build new configurations. As the card modules incorporate mezzanine cards and programmable interfaces, a user will be able to easily add new functions and upgrades to the system by simply replacing, memory devices, mezzanine cards or individual card modules. As the backplane can transfer data of different format by encapsulation techniques, it will be easy to add new formats. The backplane is based on high speed differential serial connections (up to 600 Mega-bits per second). This facility provides adequate means for future system performance. Of course, new, higher speed interface could easily be added to a card module to incorporate future high speed inter-card module communications.

The apparatus preferably further includes control means which allows the individual cards to be initialised and configured either autonomously or by remote means at apparatus power up or during apparatus use. The autonomous initialisation and configuration being based on the so called 'Plug 'n' Play' mechanism. Furthermore, in another embodiment the apparatus can be configured and controlled from a single hand held remote control device. This alleviates the need for individual remote control devices for separate sub system blocks as in the prior art home entertainment apparatus, for example separate remote control units for a television, video player and compact disc player.

In addition, the apparatus preferably includes a single visual display means for displaying the system configuration and various system parameters. This display means being implemented as one of the card functions which allows different system configurations to share the display means and hence reduce the number of display means of which there tends to be one per system sub function in previous systems.

In one preferred embodiment, data and control transfer from data sources to data processing and data sinks between the various cards is by data packets. These card intercommunications are all digital using serial or differential serial communications links so as to reduce the number of backplane signals and reduce signal noise between cards. Therefore, any analogue signals are first converted to corresponding digital signals using appropriate digital to analogue signal conversion means. The selection of such conversion means ensuring the correct sampling and quantization requirements to represent the digital form of the signal with minimal quantization and noise errors.

The switching means can take the form of a pure cross bar switch in which signal paths between the switch inputs and switch outputs are dynamically set by the host processor depending on the configuration of the apparatus. The switching means can also be a self routing buffered switch fabric in which data packets are transferred from the switch's input ports to the switch's output ports based on routing information contained in the header section of the data packet. As several inputs could route data packets to the same switch output port, buffering is required. To reduce congestion different priority queues could be used in the switch to allow higher priority traffic preference over lower priority traffic. This allows real time traffic and traffic requiring a better class of service to pass through the switch fabric with a lower latency and hence reduce timing errors. The switch paths and header fields are set by the host processor at system start-up or if there is a new configuration update.

To reduce card module and backplane routing, in-band signalling and control messages can be employed. These are identified by data fields in the cell header. Figure 10 outlines two possible frame formats for use in the apparatus. These being based on Asynchronous Transfer Mode (ATM) cell format and Point to Point Protocol (PPP) packets.

By allowing data packets to be identified by channel address means, data traffic from several sources can be routed to the same card module using the same signal path. This reduced the backplane complexity.

The advantages of using a switch card to route data packets between different card modules and devices within these card modules are that it reduces the complexity of the backplane. Each card slot does not require connections to all other possible card slot locations. Control and data messages can be switched to the correct card module via the switching means. This makes it easier to configure the system and allows the card modules to be placed almost anywhere in the apparatus card frame as the host processor card can interrogate each card to determine it's function and initialise it and the system accordingly. Also, certain card modules can incorporate Plug'n'Play means which allows card modules to initialise and or assist in configuring themselves. Another preferable feature is for the card

modules to be 'hot swappable'. This feature allows cards to be removed or inserted into the apparatus card frame while the system is operational.

The data and control packets are routed to the various destinations via a switching card having switching means to transfer control and data from many input cards to many receiving cards simultaneously. The switching action being either pre configured or self routing. The data packets preferably being of the same length as used in the Asynchronous Transfer Mode (ATM) protocol or can be varying length packets. Buffering, segmentation and reassembly and packet routing means being provided. A system could employ both such as an ADSL modem and an Ethernet based PC in which ATM data is passed over ADSL as described in T1.413 and then conversion is perform to Ethernet to allow IP to be tunnelled over Ethernet as outlined in RFC 1483 (Internet Engineering Task Force).

In a further embodiment, certain system functions are located remotely from the main system card frame apparatus. Communication with these remote units is by wireless means. This allows system functions to be moved freely within the user's home. Upgrades and additional functions can be added cheaply and more conveniently.

A specific embodiment of the invention will now be described by the way of example with reference to the accompanying drawings, in which:-

Figure 1 shows an example of the apparatus in which the card frame contains several card modules in the configuration of a hi-fidelity apparatus;

Figure 2 shows two views of the mechanics of the card frame assembly;

Figure 3 illustrates the mechanics of a basic card module;

Figure 4 shows the form of individual card modules incorporating sub module printed circuit cards;

Figure 5 shows a logical diagram of a system controller card module;

Figure 6 shows a logical diagram of a combined graphics and video processing card module;

Figure 7 illustrates a logical block diagrams of an overall system;

Figure 8 illustrates a logical block diagrams of a reduced configuration for a Personnel Computer (PC) system;

Figure 9 illustrates a logical block diagrams of a reduced configuration for a hi-fidelity system;

Figure 10 shows examples of ATM cells and variable length packets used with in the system.

In Figure 1, the home entertainment apparatus embodying the present invention includes a card frame 1a, a backplane pcb 1b and a plurality of card modules 1c. The card modules 1c are guided into position in the card frame 1a using card slider means 1h. Figure 2 shows the mechanics of a card frame. Interfacing to the power, data and control signals on the backplane 1b is via individual multi-pin connectors 1df housed on the card module 1a. The connectors consist of a male 1dm and female 1df parts to allow the board to make a good solid contact between the card module 1c and the backplane 1b. The male part of the connector 1dm being on the card module 1c and the female part of the connector 1df being part of the backplane 1b. Each card module 1c also has an interchangeable front panel 1e for housing control dials, switches and display means such as light emitting diodes (LEDs) and / or liquid crystal display (LCD) units. Two handles 1f are provided on each front panel 1e to allow easy insertion and extraction of each card module 1c to and from the card frame 1a respectively. Figure 3 shows the mechanic of a basic card module 1c.

In addition to the backplane connectors 1df, card modules 1c can also have sub module connectors 1j to allow sub module or mezzanine cards 1g to be attached to the main card module 1c. This is illustrated in Figure 4. These mezzanine cards 1g provide additional functions and allow enhancements or upgrades to be made to the current functionality. By providing such mezzanine cards 1j, upgrades can be made inexpensively and without the need to purchase whole new equipment boxes as with the prior art. The functionality provided by the mezzanine cards 1j includes adding extra memory, extra digital and analogue signal processing, adding extra software / firmware to drive the hardware in the form of ROMs, PROMs or EEPROMS and the like.

It will be noted that only one power supply module 21 is required to power the whole card frame 1a. This therefore eliminates the need for individual power supply units as would normally be found in separate equipment boxes, say in a hi-fidelity system, hence reducing the overall system costs.

To reduce backplane 1b complexity and ease upgrades to new and faster future technologies it is preferred that communication between different card modules 1c via the backplane 1b is by serial means. One such method is to employ Low Voltage Differential Signals (LVDS) technology which allow high speed serial data transfers. Backplane interface devices could then convert any desired communication protocol to LVDS signals for transmission and reception. Current LVDS devices, such as the National Semiconductor DS90C031 Differential Line Driver and the DS90C032 Differential Line Receiver can transfer data at over 155Mbps and conform to the international standards such as IEEE 1596.3.

Figure 7 shows a logical block diagram of the individual components used to form a home entertainment apparatus. Of course, not all components have to be used. A basic system could be made for implementing a hi-fi system only as shown in Figure 9. However, more card modules 1c can be added to the card frame 1a to form more complex systems which incorporate and integrate video, telecommunication and computer facilities as necessary. Figure 8 shows an example of a Personnel Computer (PC) configuration while Figure 7 illustrates a complex PC, hi-fidelity and home entertainment system. These extra system functions building on the functionality provided by other card modules 1c. Being able to add new functions allows an easy and inexpensive way to upgrade systems at a later date without having to replace whole systems. In fact, hardware and software upgrades and additions can be made to existing card modules 1c through the use of mezzanine cards 1g or sub modules as these will all conform to a standard card interface such as those used in VME or PCI systems.

Any system configuration will require a control means to initialise, control and monitor system performance. This will be provided by the host Processor Card 18. Software driver routines to control the various card functions will be stored in non volatile memory means, such as FLASH Memory, on the host card 18 and various cards 1c. Figure 5 shows a logical block diagram of a Host Processor card module 18 which incorporates the Display/Remote Control sub functions 19 and the Conditional Access Module 17. Selecting the desired system configuration and modifying the variable parameters, such as volume and tuning, is either by front panel controls or via a Hand-Held Remote Control unit 19a. Instructions are transmitted to the apparatus using an infra red link. These signals are received and decoded by the Display And Remote Control Card or sub function 19. Chosen parameters are consequently displayed on the LCD display housed on this card. Reception of signals or changes to front panel settings causes an interrupt to the Host Processor Card 18. The host processor services the interrupt and updates the corresponding system parameters by addressing the relevant function and writing the relevant data to the desired control registers. In the case of the Display and Remote Control Card or sub function 19, data is passed to the host processor via system bus means 1s. Also connected to the system bus means 1s is a Conditional Access Module or sub function 17 which is used to grant permission to use certain telecommunication services, such as pay to view television. The Conditional Access Module 17 incorporates a Smart card reader which interrogates a user's Smart card at the request of the Host processor via the system bus means 1s when certain services are requested.

The switching unit 1bs allows various system configurations to be selected by allowing data from various sources to be routed to various destinations. For example, audio data from either the Digital Audio Tape Transport Card 3 or Compact Disc Transport Card 4 or Video Transport Card 5 or Video Camera Processing Card 9 can be routed to the Audio Processing Card 11. To ensure

compatibility, all the audio source cards convert the audio data to the same format, such as the MPEG 2 Audio standard and encapsulate it in a standard packet or cell format as shown in Figure 10. Here Asynchronous Transfer Mode (ATM) cells are employed as they allow for interfacing to external systems employing different quality of services for traffic sources.

Of course, in a more comprehensive system there is no reason why more than one Audio Processing Cards 11 can not be employed. This would allow two system configurations to operate simultaneously. For example, one user could be using one Audio Processing Card 11 in a satellite television configuration via the Terrestrial Processing Interface Card 2 and another user could be using a second Audio Processing Card 1 to process signal from the Compact Disc Transport 4. Of course, the second user could be located in a different location within the home as part of the apparatus could be located in other locations and communication is via wireless (Bluetooth or IEEE802.11 wireless LAN for example) or cable means, such as Ethernet, between the two pieces of apparatus.

To help understand the apparatus a description of each of the card modules 1c shown in Figure 7 is now given.

The Terrestrial Processing Interface Card 2 provides the means to receive and decode any combination of radio, terrestrial television broadcasts and satellite broadcasts. The card 2 provides circuitry to perform RF, IF and baseband processing to enable video and audio signals to be recovered and transferred to the selected destination via the backplane or switch unit 1b and or 1bs.

Several transport cards are provided which allow systems to be expanded easily without the need for purchasing whole equipment boxes. For example, the Video Transport Card Module 5 allows

The Compact Disc Transport Card Module 4 contains a compact disc transport mechanism and associated control electronic means to load, read, write and monitor data from a compact disc. Data read from the compact disc by Compact Disc Transport Card Module 4 is processed by another card module 1c. This system partitioning allows the Compact Disc Transport Card Module 4 to be used separately in different system configurations. It can be used in an audio configuration where the data read by the Compact Disc Transport Card Module 4 is passed to an Audio Processing Card Module 11 for processing or the read data can be passed to a Video Processing Card 9 and or processing Card 18 when the system is configured for use as a Personnel Computer.

The Digital Audio Tape Transport Card Module 3 contains the transport mechanism and associated electronic means to load, read, write and monitor data to and from the DAT media. Data read from the tape media by the Digital Audio Tape Transport Card Module 3 is transferred to the selected

destination via the backplane or switch unit. Data to be written to the DAT media is transferred to the Digital Audio Tape Transport Card Module 3 from the source card module 1c via backplane and or switch means using the corresponding protocol. Instructions to control the operation of the Digital Audio Tape Transport Card Module 3 are passed to the card 3 via the backplane and or switch means from the controlling device such as the Host Processor Card 18.

The Video Tape Transport Card Module 5 contains the transport mechanism and associated electronic means to load, read, write and monitor data to and from the video tape media. Data read from the tape media by the Video Tape Transport Card Module 5 is transferred to the selected destination via the backplane or switch unit. Data to be written to the video tape media is transferred to the Video Tape Transport Card Module 5 from the source card module 1c via backplane and or switch means using the corresponding protocol. Instructions to control the operation of the Video Tape Transport Card Module 5 are passed to the card 5 via the backplane and or switch means from the controlling device such as the Host Processor Card 18.

The Digital Video Disc Transport Card Module 6 contains the transport mechanism and associated electronic means to load, read and monitor data from the video disc media. Data read from the tape media by the Digital Video Disc Transport Card Module 6 is transferred to the selected destination via the backplane or switch unit. Instructions to control the operation of the Digital Video Disc Transport Card Module 6 are passed to the card 6 via the backplane and or switch means from the controlling device such as the Host Processor Card 18.

The Disc Drive Transport Card Module 7 contains the transport mechanism and associated electronic means to load, read, write and monitor data to and from the magnetic disc media. Data read from the disc media by the Disc Drive Transport Card Module 7 is transferred to the selected destination via the backplane or switch unit. Data to be written to the disc media is transferred to the Disc Drive Transport Card Module 7 from the source card module 1c via backplane and or switch means using the corresponding protocol. Instructions to control the operation of the Disc Drive Transport Card Module 7 are passed to the card 7 via the backplane and or switch means from the controlling device such as the Host Processor Card 18.

The Video Processing Card 9 optionally contains several sub modules for converting data from several sources in to a format suitable for display on a visual display monitor and or television screen. These sub modules or mezzanine cards can be added as required to expand and improve system performance. The data can be sourced from several card modules depending on the system configuration. For example, the user could watch a television programme in which case video data from the Terrestrial processing Interface Card 2 would be transferred to the Video Processing Card 9 via the backplane and or switch means. However, if the user wished to watch a video

then the video data from the Video Tape Transport Card Module 5 would be transferred to the Video Processing Card 9 via the backplane and or switch means. Likewise, if the user configured the apparatus as a Personal Computer data displayed on the monitor 10 could be sourced from several card modules 1c, such as the Compact Disc Transport card Module 4, Disk Drive Card Module 7 or Host Processor Card Module 18. Figure 6 shows an example of a Video Processing Card Module 9. It contains an MPEG Video Decoder which converts the received digital data back into video signal. This is then passed to the PAL Encoder for formatting into PAL signals This is then modulated together with audio signals decoded on the Audio Processing Card 11. Different video outputs are available depending on the type of display used. The RGB can drive a monitor, The composite signal can be passed to a standard television where it is decoded and displayed. PAL encoding is mentioned here, but other encoding can be performed such as NTSC and SECAM.
The Video / Graphics processing Card 9 Card also contains a 2D-3D Graphics Processor module which is primarily used when the apparatus is configured for use as a Personnel Computer.

The Audio Processing Card 11 is used to process signals from several sources such as the Digital Audio Tape Transport Card 3 or the Compact Disc Transport Card 4. The audio signals are routed to the Audio Processing Card 11 via the backplane and or switch means using the appropriate protocol. The Audio Processing Card 11 performs filtering, error correction equalisation, channel separation and digital to analogue conversion functions before the processed signals are passed to either the separate channel pre-amplifiers or separate channel power amplifiers. The pre-amplification for each channel could optionally be performed on the Audio Processing Card 11 itself.

The Pre-amplifier Card 12 is used to buffer and amplify the different audio channel signals to the correct levels before they are passed to the Power Amplifier Card 13. The Power Amplifier Card has power amplification means to drive the corresponding channel loudspeakers 14. The type of power amplification employed depends on the system and performance criteria and could be either class A, class AB, class B or other forms of power amplification method.

To control the apparatus a Host Processor Card 18 is used. This can contain at least one microprocessor. More microprocessors can be added to increase system performance or be used is configurations when the apparatus is used to perform several different configuration simultaneously, such as allowing one user to watch satellite television and another user the apparatus as a personnel computer. The Host Processor Card 18 is connected to peripheral function cards by a dedicated system bus means 20. Though some memory will be provided on the Host Processor Card 18 more memory can be added by using a System Memory Card 16. The Host Processor Card can receive and transmit data from / to the Display / Remote Control Card 19. Many

apparatus control parameters can be set using a hand held Remote Control unit 19a. New system parameter settings are transmitted to the Display / Remote Control Card 19. The received signals are pre processed and passed to the host processor 18 via an interrupt mechanism means. The host processor 18 then perform the corresponding parameter changes and reconfigures the apparatus. New updates are also displayed to the user on the font panel display means.

Several apparatus configurations require conditional access as the user is required to subscribe to certain services such as digital and satellite television. The Conditional Access Module 17 is used to perform this function and interacts with the Host processor Card 18 to ensure correct apparatus configuration is maintained. The Conditional Access Module Card 17 employs, for example, SMART Card technology to perform user authentication methods.

Several of the host processor peripheral functions are quite small and could be housed on the Host Processor Card 18.

The Modem Card 15 can contain various modems to perform different apparatus configurations. For example, it can contain a cable modem to allow connection to cable service such as cable television, an ADSL modem for high speed Internet access and or a low speed modem (say a V.90 compliant modem) for Internet access. Again, as there are several types of modems for different system configurations and increases in data bandwidths means having to update modems. Employing a module approach as in the described apparatus allows upgrades to higher performance systems easily and cheaply.

Various apparatus configurations will now be explained with reference to figures 8 and figure 9.

Figure 9 show how the apparatus can be configured for use as a hi-fidelity system only. Of course, a hi-fidelity systems can contain various data source components, such as a compact disc, DAT, tuner, DAB to mention a few. However, these various signal source card modules can be added as necessary to the apparatus. The configuration shown in Figure 9 depicts a hi-fidelity system having the following card modules housed in the card frame:-

a). Power Supply Module 21,

b). Host Processor Card Module 18, which incorporates the display and remote control circuitry and some non-volatile system memory,

c). Backplane and Switch Card Module 1b and 1bs respectively ,

d). A Digital Audio Tape Transport 3,

e). A Compact Disc Transport 4,

f). A Terrestrial Processing Interface Card Module 2 configured for receiving radio broadcasts, such as AM (Amplitude Modulation), FM (Frequency Modulation) and DAB (Digital Audio Broadcast),

g). An Audio Processing Card Module 11,

h). A Pre-Amplifier Card Module 12,

i). A Power Amplifier Card Module 13 ,

j). A Loudspeaker Array 14.

k). A Modem Card 15 and

j). A Hand-Held Remote Control Unit 19a.

A Personnel Computer (PC) can be configured as shown in Figure 8. The configuration consists of the following card modules 1c:-

a). Power Supply Module 21,

b). Host Processor Card Module 18, which incorporates the display and remote control circuitry and some non-volatile system memory,

c). Backplane and Switch Card Module 1b and 1bs respectively,

d). A Compact Disc Transport 4,

e). A Disk Drive Card Module 7,

f). A Video Processing Card Module 9,

g). A Visual Display Monitor 10,

h). A Modem Card Module 15 (could be a mezzanine card module used on the Host Processor Card Module 18,

i). A System Memory Card 16,

j). An Audio Processing Card Module 11 which incorporates a low power amplifier mezzanine card module (not shown),

k). A keyboard 22,

To upgrade the Hi-fidelity apparatus outlined in Figure 9 to provide satellite reception and a home theatre facilities, the following card modules 1c need to be added:-

a). A mezzanine card for satellite reception to the Terrestrial Processing Interface Card Module 2,

b). A Video Transport Card Module 5,

c). A Digital Video Disc Transport Card Module 6,

d). A Video Processing Card Module 9,

e). A Visual Display / Monitor 10.

CLAIMS

1. An integrated home entertainment and telecommunication apparatus comprising an expandable modular card frame means, an associated backplane system for distributing both analogue and digital signals together with power supply signals to each card location, a plurality of card modules each including connector and interface means for interfacing to the said backplane, each card module performing a sub function of the desired overall system and optionally having means to support mezzanine cards for implementing more sophisticated additional support functions, in such apparatus the system functionality being partitioned amongst the various modular cards in such a way as to optimise overall system functionality by allowing different system configurations to share common functional resources, hence reducing duplication of certain common functions, these said cards consisting of;

- internal data source card modules providing a data stream from stored media means,
- external data interface card modules which interface the said apparatus to externally generated data or signals,
- a switching or routing card which transfers data packets to and from the various source and destination functions within the said apparatus based on an appended routing tag and or an enclosed address field,
- digital and analogue processing cards incorporating signal processing means for processing common (similar) data from a plurality of input card modules, the said processed data being transferred to one or several of a plurality of selected output cards using appropriate interfacing means,
- output card module means for transferring the received processed data in the correct format to signal sink means,
- and power supply cards for providing and distributing power to the plurality of cards in the assembled apparatus.

2. Apparatus as claimed in claim 1 wherein certain control messages and data messages are contained in fixed length and or variable length packets and routed to different functional units within the apparatus via serial or differential serial means, the packets being routed using switching means and the switching action being determined by routing information contained in the packet header.

3. Apparatus as claimed in claim 1 wherein certain control messages and data messages are routed to different functional units within the apparatus via parallel bus means, the packets being routed using switching means and the

switching action being determined by routing information contained in the packet header.

4. Apparatus as claimed in claim 2 wherein the switching means can be of a cross bar structure or a priority buffered switch allowing traffic from various channels to use the same data paths bewteen card modules and hence reduce backplane wiring.

5. Apparatus as claimed in claim 2 wherein certain apparatus functions are performed remotely from the main apparatus in which control and data messages are transferred by wireless means allowing movement of the said remote functions to different locations within the user's house without the need to re-wire the apparatus.

6. Apparatus as claimed any previous claim wherein the card module interface means are based on programmable logic, for example Field Programmable Logic Arrays (FPGAs) so upgrades can be easily implemented by changing the interface devices of the associated card module.

7. Apparatus as claimed in any previous claim wherein the apparatus can be configured to implement different apparatus configurations simultaneously allowing more than one user to use the apparatus.

8. Apparatus as claimed in any previous claim wherein the apparatus consists of more than one card frame unit which are connected by wire means and or wireless means.

9. Apparatus as claimed in any previous claim wherein the front panels of the card modules can be changed to ones of a different design, colour, texture and material to suite different user's tastes.

10. Apparatus as claimed in any previous claim wherein the card modules incorporate 'Plug and Play' means to allow a card module to configure and initialise itself and interact with the host processor means to indicate the configuration, status and functionality of the card module and associated mezzanine card modules.

11. Apparatus as claimed in any previous claim wherein the card modules incorporate the means to be hot swappable allowing card module insertion or removal from the apparatus card frame while the apparatus is operational.

12. An integrated home entertainment and telecommunication apparatus substantially as described herein with reference to Figures 1-10 of the accompanying drawings.

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Claims searched:	1 to 12	**Date of search:**	13 May 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): G5R (RAC, RAD, RB15, RB25, RGA)

Int Cl (Ed.6): G06F 1/18 G11B 33/00, 33/06, 33/12

Other: Online: EPODOC; WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	WO 97/23818 A2	(NEOSYSTEMS)	1 to 11
X	WO 97/02570 A1	(PEACOCK)	1 to 11
X	US 5801921	(MILLER)	1
X	US 5706179	(PALATOV)	1 to 11
X	US 5546273	(HARRIS)	1
X	US 5339362	(HARRIS)	1

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Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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